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IB/OS 50855

Patentanmeldung Nr. Patent application No. Demande de brevet n°

04101186.7

**PRIORITY  
DOCUMENT**

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p.o.

R C van Dijk



Anmeldung Nr:  
Application no.: 04101186.7  
Demande no:

Anmeldetag:  
Date of filing: 23.03.04  
Date de dépôt:

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:  
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Recording a number of sets of data on a storage medium

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s)  
revendiquée(s)  
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/  
Classification internationale des brevets:

H04N9/79

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of  
filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IT LU MC NL  
PL PT RO SE SI SK TR LI

## Recording a number of sets of data on a storage medium

## TECHNICAL FIELD

The present invention is generally directed towards recording of sets of data on a data carrier, for instance the recording of television programs, and in particular directed towards providing a method and device for recording multiple sets of data on a data carrier.

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## BACKGROUND OF THE INVENTION

Programs in the form of video or audio are today broadcast in a multitude of ways. Here it is sufficient to mention the Internet and broadcasting over the air. It has furthermore long been known to record data on different types of data carriers.

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When recording data it is nowadays often common to code digital data using different coding algorithms. One such type of coding is the MPEG standard, where often MPEG1 or MPEG2 are used. In these standards it is possible to vary the recording quality by varying the bit rate of the data that is recorded, which is often used for fitting a set of data to be recorded onto the recording medium. The actual space occupied is furthermore very hard 15 to determine beforehand because of the coding algorithms used.

15

In the art it is known to fit a recorded set of data to the size of the available space on a recording medium by allowing the recording quality to deteriorate.

20

One such scheme is described in US 6,584,272, which describes the determination of an allowable recording time period for a set of data in the form of a program given a certain free space up until the end of a disc or up until some point before the end of disc in order to reserve some additional space. Given the available area of the disc a maximum recording time period with a lowest quality, a lowest recording time with a highest recording quality and an average recording time with an average recording quality are indicated to a user. Depending of the length of time wanted to be used for recording by the 25 user and different quality settings that can be made by him/her, the user is informed if the set of data can be recorded with the selected quality or not. This allows the user to either change the time of recording or the quality of recording based on the remaining area on the disc.

However, for a user the quality of the recording is often of secondary interest.

Often it is more important to make sure that the recording is made and to allow the user not

having to decide between different qualities of the recording. A user might furthermore often program several programs to be recorded in one go and want them to fit into the available space without further involvement. The above-described scheme is in this respect not quite satisfactory since it is based on the recording of only one set of data at a time. Since the 5 scheme is directed towards fitting one set of data to the disc, there might not be space left for other sets of data on the same disc, since an optimization has been made only for one set of data.

There is thus a need for a recording scheme, which determines the available space and fits more than one program into this space.

10

## SUMMARY OF THE INVENTION

The present invention is therefore directed towards solving the above-mentioned problem associated with fitting several sets of data into an available space of a recording medium.

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One object of the present invention is thus to provide a method of recording multiple sets of data on at least one data carrier, which determines the available space and fits more than one program into this space.

According to a first aspect of the present invention, this object is achieved by a method of recording multiple sets of data on at least one data carrier comprising the steps of:

20

reading program information regarding at least two different sets of data to be recorded on the at least one data carrier in a timed recording sequence, which information comprises the length of time used by each set of data when being played,

calculating the recording length of all sets of data,

25 determining the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence,

setting recording quality for all sets of unrecorded data in the timed recording sequence that corresponds to a fitting of all sets of data to the available space,

recording a set of data with the set recording quality, and

30 repeating the steps of determining, setting and recording for each set of unrecorded data, until all sets have been recorded.

Another object of the present invention is to provide a device, which enables recording of multiple sets of data on at least one data carrier through determining the available space and fitting more than one program into this space.

According to a second aspect of the present invention, this object is achieved by a device for recording multiple sets of data on at least one data carrier comprising:  
a recorder arranged to record at least two sets of data on the at least one data carrier,

5 a storage medium controller for receiving the at least one data carrier,  
at least one program timer comprising program information regarding at least two different sets of data, which information comprises the length of time used by each set of data when being played, and

10 a control unit arranged to  
read the program information regarding said at least two sets of data  
which are to be recorded on said at least one data carrier in a timed recording sequence,  
calculate the recording length of all sets of data,  
determine the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence,

15 set recording quality for all sets of unrecorded data in the timed recording sequence that corresponds to a fitting of all sets of data to the available space,  
order the recorder to record a set of data with the set recording quality, and

20 repeat the determining, setting and ordering of recording for each set of unrecorded data, until all sets have been recorded.

Claims 2 and 13 allows recording of a set of data with a fixed recording quality, which allows a user to select a fixed higher quality if he is interest in getting good quality in the recording of one program.

25 Claims 3 and 14 are directed towards adding sets of data to be recorded to the timed recording sequence.

Claims 4 and 15 is directed towards adjusting the timed recording sequence because of a directly recorded program.

Claims 5, 6, 7, 16, 17 and 18 are directed towards different types of start and end markers on the at least one data carrier for determining the available recording space.

30 Claims 8 and 19 are directed towards moving the start marker in order to change the available recording space.

Claims 9 and 20 are directed towards removing program information about a set of data to be recorded, which allows an increase of the recording quality.

According to claims 10 and 21 the available storage space includes protected areas that split the timed recording sequence into fragments. Sets of data are then fit into these fragments.

With the present invention recording of sets of data is guaranteed and fit to an 5 available recording space of at least one data carrier. The recording quality can furthermore be set to the highest possible recording quality. A user is furthermore relieved from having to be involved every time an actual recording is to take place, but need only be this at the start of setting of a recording sequence.

10 The basic idea of the invention is to determine the available recording space on at least one data carrier for all unrecorded sets of data of a timed recording sequence to be recorded on the at least one carrier, set recording quality for all sets of unrecorded data in the timed recording sequence to fit to the available space, record a set of data with the set recording quality, and repeating determining, setting and recording for each set of unrecorded data, until all sets have been recorded.

15 The above mentioned and other aspects of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

#### BRIEF DESCRIPTION OF THE DRAWINGS

20 The present invention will be further described in relation to the accompanying drawings, in which:

fig. 1 shows a block schematic of a device according to the present invention, and

fig. 2 shows a flow chart of a method of recording according to the present invention.

25

#### DETAILED DESCRIPTION OF THE INVENTION

The present invention is generally directed towards the recording of a received media data streams. The data is then often broadcast over different channels. Such broadcasts is in the preferred embodiment of the invention television programs broadcast on television 30 channels, which can be normal airborne channels as well as satellite channels or cable TV channels or perhaps web TV channels. It is however possible that the broadcasting channels can be different type of radio channels as well, such as web radio channels or radio channels sent via air, satellite or cable. The broadcast information is thus media data in the form of programs, television or radio as well as separate pieces of programs such as video or pieces

of music. The recorder according to the present invention to be described is therefore an optical disc recorder of the type Digital Versatile Disc (DVD) recorder, but it can also be other types of recorders like hard-disc recorders or other types of recorders for just recording sound. It can furthermore be another type of optical disc recorder, like a Blu-Ray disc recorder or an HDTV recorder.

Fig. 1 shows a block schematic of a device for recording multiple sets of data on a data carrier according to the invention in the form of a recorder 10. The recorder 10 is connected to an antenna 12, which can receive information in the form of television programs broadcast by different television network operators. The antenna can be provided as a part of the recorder or as a separate entity to which the recorder 10 is connected. As television programs can be transmitted by other means than via the air, the recorder 10 does not have to be connected to an antenna 12, but can be connected to a satellite dish either directly or via a satellite receiver or to a cable of a cable supplier. The antenna 12 is connected to a receiver 14 within the recorder 10, which can be set to tune to different transmission frequencies. The receiver 14 also comprises an A/D converter for converting analog signals to digital signals. This A/D-conversion functionality would however not be needed if the signals were already digital. The receiver 14 is connected to a signal coding unit 16, which codes the digitalized television programs received by the receiver into coded sets of media data according to a suitable coding algorithm such as MPEG2 or MPEG1 and stores them on an optical disc 20 via a storage medium controller in the form of a disc controlling unit 18. The recorder 10 furthermore includes a control unit 22 controlling the coding unit 16, the receiver 14 and the disc controlling unit 18. According to the invention there is also provided a first program timer 24, a second program timer 26 and a third program timer 28, each connected to the control unit 22. It should be realized that there can be more or fewer program timers than shown in the figure. There is furthermore provided a user input unit 30, for receiving information input by a user of the recorder 10. It should however be realized that information could just as well be input via a remote control communicating with an interface unit connected to the control unit 22 either in addition to or instead of the user input unit 30. The recorder 10 furthermore includes an information presentation unit, here in the form of a display 32, for showing visual information to the user. It should also be realized that the recorder does not have to present visual information to the user, but this information can just as well be audio information, in which case the recorder 10 does not need to include a display. Visual information to be displayed to a user can also be displayed using a connected display device, like a television set.

General operation of the device will now be described. The receiver 14 can be tuned to several different channels, all broadcasting information in the form of media streams or programs. A user of the recorder 10 can program a program timer 24, 26 or 28 for recording a program on any channel receivable via the receiver 14. When doing this the user

5 can manually program for instance the first program timer 24 with settings about a first program to be recorded, where this information includes information about which channel is to be recorded, the start time of the recording and the end time of the recording. He can also program the second program timer 26 for recording a later broadcast program, which is perhaps broadcast on a different channel. Also the third program timer 28 can be

10 programmed in the same way. As an alternative to manual entry of this information into the first timer, the user can program the timer via an EPG (not shown). The information of channel, start time and end time is then present in the EPG and this information is transferred from the EPG to the corresponding program timer under the control of the control unit 22. All the user really has to do in this case is to select program in the EPG and confirm the

15 selection. Other alternatives of programming a timer are to transfer this information from teletext pages received via a channel. The control unit 22 then looks at the settings of the program timer 24 and controls the receiver 14 to tune to the programmed channel and the coding unit 16 to code the received program on the channel and store the program on the disc 20 via the disc controlling unit 18.

20 When doing this recording it is however necessary to ensure that the programs can be recorded on the disc, i.e. that there is sufficient space for storing the information. This is not a trivial problem, since the coding techniques used today, for instance MPEG, which are efficient with respect to the amount of information stored, nevertheless use a coding for which it is difficult to know in advance how much space a recorded program actually

25 occupies.

A preferred embodiment of the invention will now be described with reference being made to fig. 1 and 2, where the latter shows a flow chart of a method according to the invention.

30 After a user has inserted a disc 20 in the disc controlling unit 18 and programmed the first, second and third program timer 24, 26 and 28 with program information relating to the recording of three different programs, the control unit 22 reads the settings of the timers, step 34. The settings includes the start and end time of each program, from which information about the length of each program can easily be deducted. These programs then make up a timed recording sequence regarding different sets of media data

that are to be recorded. The control unit 22 thereafter calculates the total recording length based on these settings, i.e. the total time of these recordings, step 36. After that the control unit 22 goes on and determines the available recording space on the disc 20 for all the programs in the timed recording sequence, which are all unrecorded at this stage, step 38.

- 5 The available recording space is here the space from the position of a positional pointer in the form of a disc pointer until an end of disc marker. When the control unit 22 has done this, it sets a recording quality or bit-rate for all the unrecorded programs in the timed recording sequence for allowing fitting on the available area of the disc 20, step 40. The recording quality is here set as high as possible for enabling fitting the programs on the disc. Thereafter
- 10 the control unit 22 orders the recording of the first of the programs to be recorded according to the settings in the corresponding program timer with the set quality, step 42. In this example information about the first program in the sequence is provided by the first program timer 24, information about a second program in the sequence by the second program timer 26 and information about a third program in the sequence by the third program timer 28. This
- 15 is done through the control unit 22 making the receiver 14 to tune to the channel in question and starting the coder 16 at the time set in the first program timer 24 and making the coder 16 end the coding at the time set in the first program timer 24 and at the same time ordering the coder 16 to use the set quality. The receiver 14 then receives the media stream and the coder 16 codes this stream for instance using MPEG1 or MPEG2. The coder 16 is then made to
- 20 forward the coded program in the form of a set of data or data file to the disc controlling unit 18, which stores the set of data or program from the original position of the disc pointer and forwards. In the storing, the disc pointer is continuously moved forward, step 44, until it reaches a position where the stored set of data or media file ends. The control unit 22 now goes on and checks if there are more unrecorded programs in the timed recording sequence,
- 25 step 46. If there are not, step 46, recording is ended, step 48. But if there are, step 46, the control unit 22 determines the available recording space on the disc after this first recording for the yet unrecorded programs, step 38, and sets the recording quality once again in order to fit the remaining programs on the disc, step 40. This recording quality can then be different than the one first used. Thereafter recording of the next program in the timing sequence is
- 30 recorded based on the settings in the second program timer 26 with this new recording quality, step 42, and the disc pointer moved, step 42. In this way the control unit goes on checking available recording space and changes the quality of recording for fitting into the available recording space until all the programs in the sequence have been recorded and in this example until a program according to the third program timer 28 has been recorded.

In this way recording of programs are performed for several programs while ensuring the best possible quality and fitting the recorded programs to the disc. The user does furthermore not have to be involved in the recording process more than necessary and above all does not have to decide for him/herself if a program will fit or not, which makes the

5 invention very user friendly.

The control unit is preferably provided in the form of one or more processors together with corresponding program memory containing software code for enabling performance of the acts associated with the control unit. The program timers are normally provided as memory space. The coder can either be provided in the form of hardware, 10 perhaps as an ASIC circuit, but also in the form of software running on a computer, whereas the disc controlling unit is normally provided as hardware.

There are several variations that can be made to this basic concept of the invention. It is possible that the programs in the timed recording sequence cannot fit to the available recording space, in which case the control unit goes on and informs the user of this 15 fact via the display. Then the user can select to remove a programmed recording in order to enable the fitting to the available recording space. It is also possible that the control unit orders the recording of as much as possible of the last program in the sequence or removes portions at the beginning and/or end of the last recording. It can also select another recording to be truncated.

20 Another possible variation that exists is that the user can set a certain fixed recording quality for a certain program. The control unit would then order the recording of this program with this fixed quality, but set the recording qualities of the other programs to fit to the available recording space with at least the lowest possible quality or bit-rate supported. In this way a user can select a certain quality for one program for which he is most interested 25 in getting a good quality, while still allowing the other programs to be fit to the available space on the disc. If it is allowed the timed recordings are recorded with the highest possible quality.

It is furthermore possible that the user can move the position of the disc 30 pointer either backwards or forwards when initiating a timed recording sequence in order extend or reduce the recording space. However, then the control unit checks the program information in order to find out if all timed recordings can be recorded with at least the lowest supported quality. If it is allowed the timed recordings are recorded with as high a quality as is possible.

Yet another variation of the present invention is that the user can add a new recording by programming a timer after the timed recording sequence has been set. In this case the control unit checks if it is possible to add the new timed recording to the sequence with at least the lowest possible quality used for all programs that remain to be recorded. If it 5 is possible, the addition is allowed and otherwise the user is informed about the fact that it cannot be entered or be entered while recording less than the totality of the programs in question. If it is allowed the timed recordings are recorded with as high a quality as is possible.

Another variation is that the user can directly decide to record a program 10 without programming a timer, so called one touch recording or direct recording. In this case the control unit checks, after the user selected program has been recorded, if the recording of the remaining programs in the timed recording sequence can be recorded with at least the lowest possible quality. If it is allowed the timed recordings are recorded with as high a quality as is possible.

Another situation that can occur is that the disc might have areas of protected 15 recordings between the original position of the disc pointer and the end of disc marker. In this case the available space is divided into fragments. When the control unit determines the available space of the disc, these protected areas are not taken into consideration. Furthermore, the qualities of the programs are selected to fit into the fragments, i.e. a 20 consideration of the size of each separate fragment is made and the program for a fragment is selected based on if it can fit into the fragment or not.

It is furthermore possible that the disc controlling unit can receive several 25 discs simultaneously. In this case the fitting of programs to the available recording space according to the invention can be applied on all or some of these discs according to the wishes of the user. Then the available recording space is defined by the disc pointer of the first disc and the end of disc marker of the last disc to be used for recording. The disc pointers and end of disc markers in-between these markers then indicate fragments of the available recording space where programs can be recorded.

It is also possible that the user removes a program from the timed recording 30 sequence. The freed disc space is then added to the remaining available recording space and used for fitting the remaining programs of the timed recording sequence. This enables an increase of the recording quality.

The available space was above described as being provided between a disc pointer and end of disc marker. It is equally as well possible that the user can select his own

start and/or end markers to define the disc space available for recording. The data carrier was above described in relation to an optical disc. It should however be realized that the invention can be used on other types of data carriers and storage mediums, like memory sticks, hard discs, memory cards etc.

CLAIMS:

1. Method of recording multiple sets of data on at least one data carrier (20)

comprising the steps of:

reading program information regarding at least two different sets of data to be recorded on the at least one data carrier in a timed recording sequence, which information

5 comprises the length of time used by each set of data when being played, (step 34),

calculating the recording length of all sets of data, (step 36),

determining the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence, (step 38),

10 setting recording quality for all sets of unrecorded data in the timed recording sequence that corresponds to a fitting of all sets of data to the available space,

recording a set of data with the set recording quality, (step 40), and

repeating the steps of determining, setting and recording for each set of unrecorded data, until all sets have been recorded.

15 2. Method according to claim 1, wherein the program information concerning one set of data comprises a fixed recording quality and the step of setting recording quality comprises setting the fixed recording quality to said one set of data and setting a recording quality for the other sets of data that corresponds to a fitting to the available space.

20 3. Method according to claim 1, further comprising the step of reading program information regarding another set of data not provided in the timed recording sequence, determining if the new set of data can be included in the timed recording sequence at least with the lowest possible recording quality, and including the added set of data in the sequence if it is possible.

25 4. Method according to claim 1, further comprising the step of identifying a manual recording of a set of data on the at least one data carrier, determining if unrecorded sets of data in the timed recording sequence can be recorded with at least the lowest possible

recording quality on the at least one data carrier when the manual recording is ended and changing the recording quality if possible and necessary.

5. Method according to claim 1, wherein the available recording space is determined by a start marker and an end marker related to the at least one data carrier.
6. Method according to claim 5, wherein the start marker is a positional pointer and the end marker is an end of carrier marker.
- 10 7. Method according to claim 5, wherein the start and end markers are user defined start and end markers.
8. Method according to claim 5, further comprising the step of changing the available recording space by moving the start marker.
- 15 9. Method according to claim 1, further comprising the step of detecting the removal of program information relating to a set of data and repeating the steps of determining, setting and recording for each set of unrecorded data for the remaining unrecorded sets of data after said removal.
- 20 10. Method according to claim 1, wherein the recording space of the at least one data carrier where the timed recording sequence is to be stored comprises at least one protected area splitting said available recording space into fragments, wherein the step of setting of recording quality comprises adjusting the recording quality for unrecorded sets of data to fit into the fragments and further comprising the step of selecting unrecorded sets of data for storage in fragments having a large enough size.
- 25 11. Device for recording multiple sets of data on at least one data carrier (20) comprising:
  - 30 a recorder (16) arranged to record at least two sets of data on the at least one data carrier,
    - a storage medium controller (18) for receiving the at least one data carrier, at least one program timer (24, 26, 28) comprising program information regarding at least two different sets of data, which information comprises the length of time

used by each set of data when being played, and

a control unit (22) arranged to

read the program information regarding said at least two sets of data

which are to be recorded on said at least one data carrier in a timed recording sequence,

5 calculate the recording length of all sets of data,

determine the available recording space on the at least one data carrier for all unrecorded sets of data of the timed recording sequence,

set recording quality for all sets of unrecorded data in the timed recording sequence that corresponds to a fitting of all sets of data to the available space,

10 order the recorder to record a set of data with the set recording quality, and

repeat the determining, setting and ordering of recording for each set of unrecorded data, until all sets have been recorded.

15 12. Device according to claim 11, further comprising a receiver (14) for receiving media streams corresponding to sets of data to be recorded.

13. Device according to claim 11, wherein the program information concerning one set of data comprises a fixed recording quality and the step of setting recording quality 20 comprises setting the fixed recording quality to said one set of data and setting a recording quality for the other sets of data that corresponds to a fitting to the available space.

14. Device according to claim 11, wherein the control unit is further arranged to read program information regarding another set of data not provided in the timed recording sequence, determine if the new set of data can be included in the timed recording sequence, at 25 least with the lowest possible recording quality, and include the added set of data in the sequence if it is possible.

15. Device according to claim 11, wherein the control unit is further arranged to 30 identify a manual recording from a user of a set of data on the at least one data carrier, determine if unrecorded sets of data in the timed recording sequence can be recorded with at least the lowest possible recording quality on the at least one data carrier when the manual recording is ended and change the recording quality if possible and necessary.

16. Device according to claim 11, wherein the available recording space is determined by a start marker and an end marker related to the at least one data carrier.

17. Device according to claim 16, wherein the start marker is positional pointer and the end marker is an end of carrier marker.

18. Device according to claim 16, wherein the start and end markers are user defined start and end markers.

10 19. Device according to claim 16, wherein the control unit is further arranged to order the storage medium controller to move the start marker in order to change the available recording space.

15 20. Device according to claim 11, wherein the control unit is further arranged to detect the removal of program information relating to a set of data from the program timer and repeat determining, setting and recording for each set of unrecorded data for the remaining unrecorded sets of data after said removal.

20 21. Device according to claim 11, wherein the recording space of the at least one data carrier where the timed recording sequence is to be stored comprises at least one protected area splitting said available recording space into fragments and the control unit is further arranged to, when performing setting of recording quality, adjust the recording quality for unrecorded sets of data to fit into the fragments and to select unrecorded sets of data for storage in fragments having a large enough size.

**ABSTRACT:**

The invention concerns a method and device (10) for recording sets of data on a data carrier (20). The device includes a recorder (16), a storage medium controller (18) receiving the data carrier, a control unit (22) and program timers (24, 26, 28) having program information regarding sets comprising the length of time for each set when played. The 5 control unit (22) reads program information regarding sets to be recorded in a timed recording sequence, calculates the recording length of all sets, determines the available recording space on the data carrier for all unrecorded sets of the sequence, sets recording quality for all sets of unrecorded data in the sequence corresponding to a fitting of all sets to the available space, orders recording of a set with the set recording quality, and repeats 10 determining, setting and ordering recording for each set of unrecorded data, until all sets have been recorded.

Fig. 1

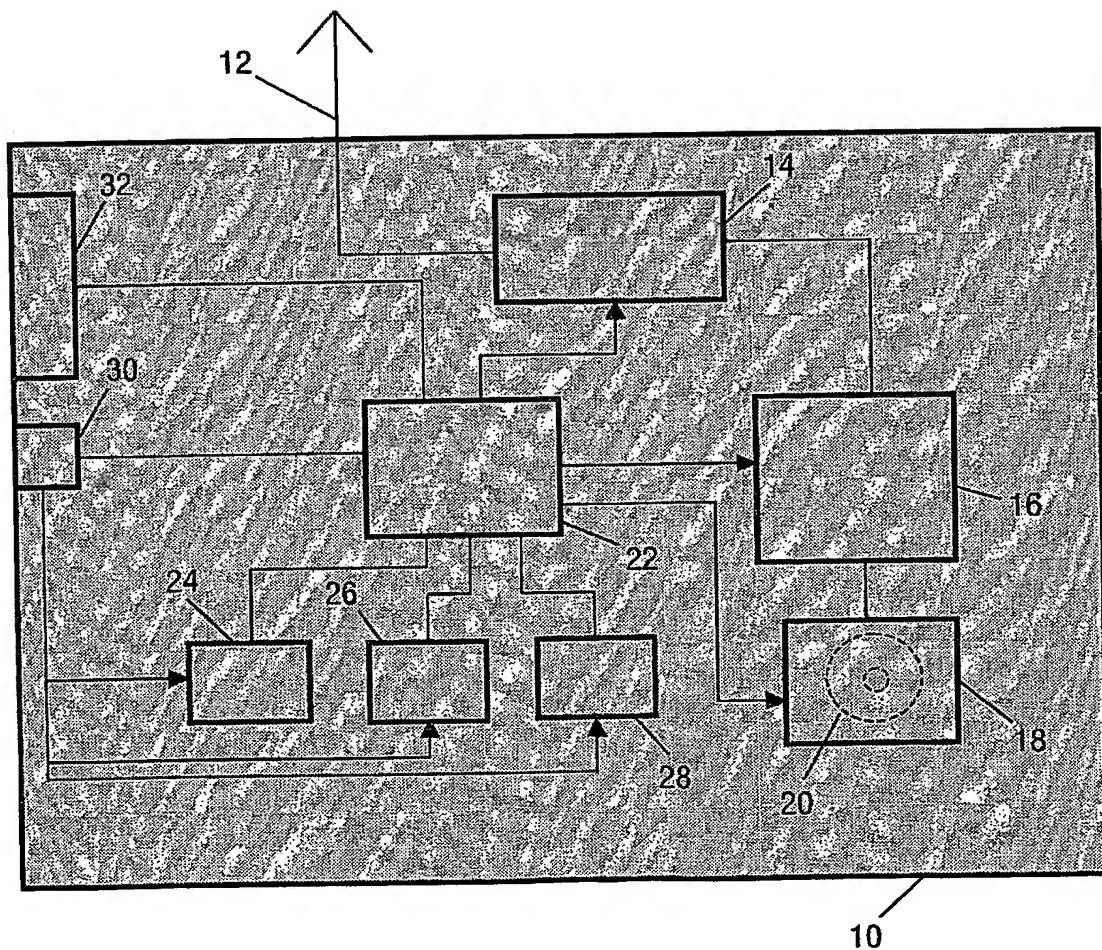


FIG.1

2/2

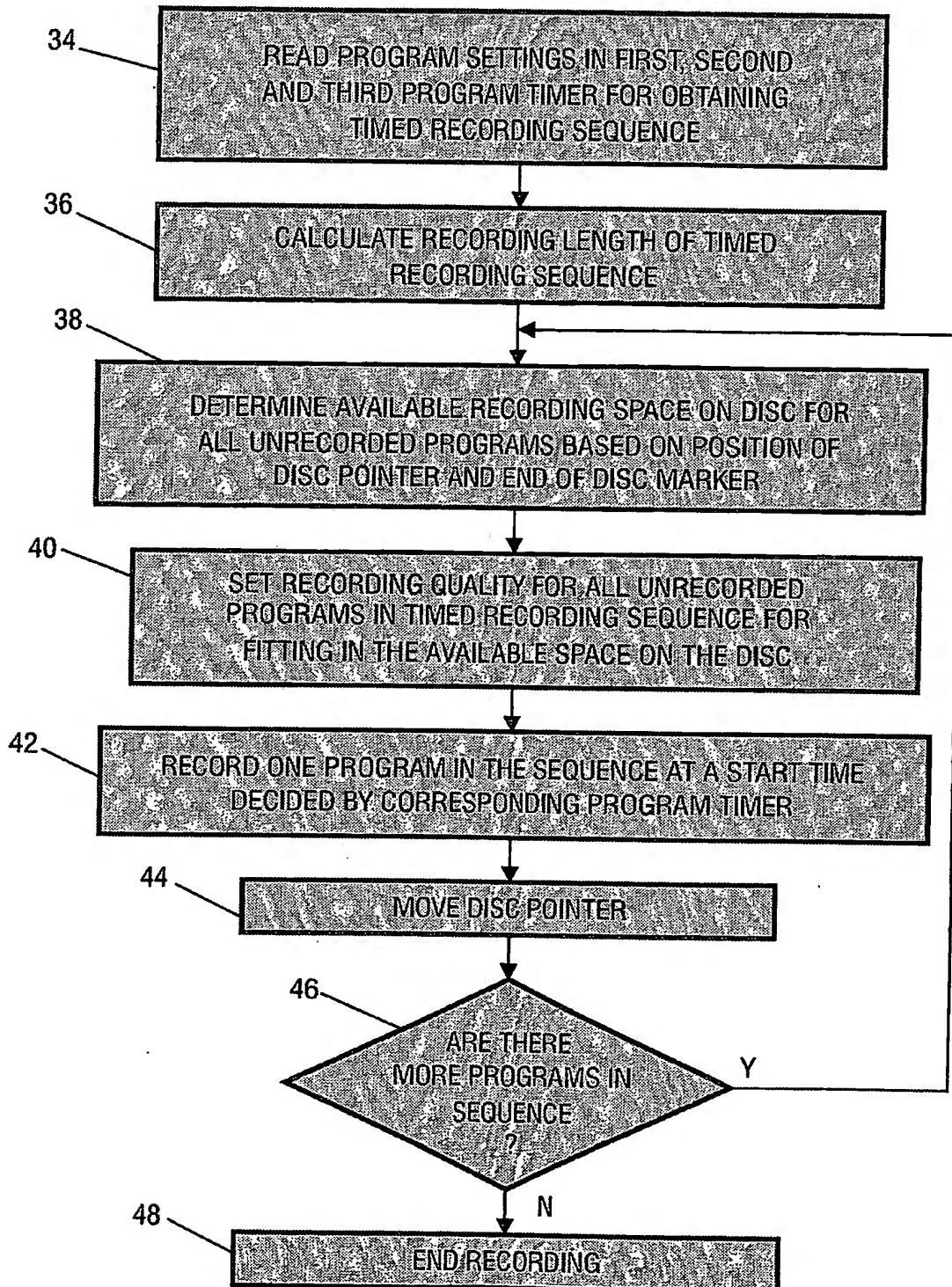


FIG.2